DOCUMENT RESUME

ED 424 287 TM 029 170

AUTHOR Gordon, Howard R. D.
TITLE Identifying Learning Styles.
PUB DATE 1998-07-20
NOTE 27p.; Paper presented at the Annual Summer Workshop for Beginning Vocational Education Teachers (Montgomery, WV, July 20, 1998).
PUB TYPE Information Analyses (070) -- Speeches/Meeting Papers (150)
EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Cognitive Style; Educational Environment; *Environmental Influences; *Identification; *Individual Differences; *Perception; Performance Factors; *Student Characteristics

ABSTRACT

Learning style is a factor researchers claim influences student educational performance. This article summarizes information about student learning styles. The idea of learning styles is based on the theory that there are different methods of gathering, organizing, and evaluating information. Research has not produced conclusive evidence about learning styles, but there is information about learning conditions and cognitive learning styles that can provide some insight into learning styles. One area to consider is that of learning conditions. Many environmental factors can affect a person's ability to concentrate and absorb and retain information. Another approach is to determine a person's cognitive learning style, based on how information is best perceived and the preferred way of perception, how information is organized and processed, and how progress toward understanding takes place. Characterizing learning style as field-dependent or field-independent is an approach with many applications in education. Those who have a field-dependent style are more likely to view the world globally, and have to use the organization in which learning material is presented. Those who have a field-independent learning style tend to view the world more analytically, solve problems more easily, and favor inquiry and independent study. They are more likely to provide their own structure to facilitate learning. Of course, learning styles are not always clustered into neat categories. Another way to view learning styles is that of A. Gregorc and K. Butler (1984) who refer to four channels through which the mind receives and expresses information most efficiently. These include the perception abilities of abstractness and concreteness and the ordering abilities of sequence and randomness. Combining these results in concrete sequential, abstract sequential, abstract random, and concrete random ways of seeing and using information. Learning modalities are also characterized as kinesthetic, tactual, auditory, and visual. By being aware of individual learning styles, including the preferences individuals have for learning conditions, vocational education teachers can develop alternative instructional methods and a variety of learning resources. (Contains 1 table, 2 figures, and 19 references.) (SLD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 424 287

Identifying Learning Styles

Howard R. D. Gordon

Marshall University

Department of Adult and Technical Education

434 Harris Hall

Huntington, West Virginia 25755

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☐ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Howard Gordon

Paper presented at the annual Summer Workshop for Beginning

Vocational Education Teachers

West Virginia University Institute of Technology

Montgomery, West Virginia 25136

July 20, 1998

TM029170

BEST COPY AVAILABLE

Identifying Learning Styles

Introduction

For decades American schools have treated students as if they all learned alike (Flaherty, 1992). The United States is moving toward a global, information-based economy, with an increasingly diverse workforce. One result of these changes is a need for better trained, competent teachers, professionals, and technicians who are capable of using complex technologies to improve services, increase quality, and raise productivity. Also more jobs require individuals to reason in high-level abstract terms in order to make inferences and solve intricate problems.

The traditional methods and procedures of teaching, with their limiting results, are no longer acceptable. A number of factors that influence the educational process have emerged from research on human developmental stages and life phases. Learning style is one factor researchers claimed influenced student educational performance.

The purpose of this theoretical article was to describe and gather information about selected student learning styles.

Learning Styles

Student learning styles are based upon the theory that there are different methods of gathering, organizing, and evaluating information. Some people

have consistent ways of selecting information and have dominant styles while others are more flexible in their approaches. Some people prefer to learn a skill by manipulating concrete object, some by listening, some by reading a manual, and some by interacting with others. In brief, peoples have unique and characteristic ways of using their mind (Kazmierski, 1977).

Learning style is not a new concept. However, because educational practitioners started to investigate learning styles at about the time most psychologists were losing interest, progress in the area has been slow (Keefe and Monk, 1986). Learning style has been defined as the "Composite of characteristic cognitive, affective, and psychological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment" (Griggs 1991, p.7). Griggs (1991) noted that it is important to recognize that learning styles are not related to intelligence, mental ability or actual learning performance and that no particular learning style is better than another style.

Although research has not produced conclusive evidence about learning styles, there is information about learning conditions and cognitive learning styles that can provide some insight into learning styles. Most of the learning style research (Cano, Garton, & Raven, 1992a, 1992b; Cano & Metzger, 1995; Garton, 1993; Torres, 1993) done by members of the vocational education profession involved assessment of the field-dependence/independence

psychological dimension. This dimension relates to global vs. Analytical perceiving and the ability to perceive items without being influenced by the surrounding field (Chinien & Boutin, 1993).

Learning Conditions

Many environmental factors in the classroom can affect a person's ability to concentrate and to absorb and retain information. For example, we all know of teenagers who can best study with music blasting at full volume from a nearby radio. They feel comfortable with a noise background and ignore it when they concentrate. Therefore, how each person responds to sound, as one factor in the learning environment, may be an important consideration for that person's successful learning.

Dunn and Dunn (1978) have designed a Learning Style Inventory for school-age learners and a second instrument for adult learners. These questionnaires contain statements to which an individual responds (by acceptance or rejection). The result is an analysis of the conditions under which the person prefers to learn. The assessment of individual preferences covers the following areas:

1. Immediate *physical environment*, in relation to sound, light, and temperature levels, and choice or arrangement of furniture.
2. Individual *emotionality*, in relation to motivation, taking responsibility, and being persistent in completing as task.

3. Individual *sociological* needs, in relation to being self-oriented, peer or group oriented, adult oriented, or of combined orientations.
4. Individual *physical* needs, in relation to perceptual preferences, need for mobility, daily use of time, or biorhythm for efficient functioning.

By examining the individual profiles of learners after completing an inventory, the instructor, in consultation with the learner, can offer suggestions and help create a suitable learning environment. This can be of particular value when students are engaged in an individualized or self-paced learning program.

Cognitive Learning Styles

Another approach to analyzing the factors that affect how a person is most likely to learn is to determine that person's cognitive learning style. Individuals are classified on a number of scales according to how they receive and process information. A student's cognitive learning style can be defined using inventories and questionnaires. Felder and Silverman (1988) have developed one set of common categories for analysis:

1. How information is best perceived
   - *visual* - through pictures, diagrams, demonstrations
   - *auditory* - through words and sounds
2. Type of information preferentially perceived
   - *sensory* (external) - sights, sounds, physical sensations

- *intuitive* (internal) - insights, hunches

3. How information is organized
   - *inductive* from facts and observations to infer principles
   - *deductive* - from principle to deduce applications and consequences
4. How information is processed
   - *actively* - physical engagement or discussion
   - *reflectively* - introspection
5. How progress toward understanding takes place
   - *sequentially* - as series of related steps
   - *globally* - as large jumps or holistically

Following are some useful techniques for general application (terms in parentheses refer to categories of cognitive learning style behaviors listed earlier) as developed by Felder and Silverman (1988):

- Relate information being presented to what has come before and what is still to come (*inductive/global*).
- Provide a balance of concrete information and abstract concepts (*sensory/intuitive*).
- Balance material that emphasizes practical problem-solving methods (*sensing/active*) with material that emphasizes fundamental understandings (*intuitive/reflective*).
- Use pictures, schematics, and simple sketches along with verbal information (*sensory/active*).
- Provide demonstrations (*sensing/visual*), hands-on activities (*active*), and computer-based learning (*sensing/active*).

- Provide intervals during presentations for students to think about what they have been told (*reflective).*
- Assign drill exercises to provide practice (sensing/active/sequential).
- Provide open-ended problems and exercises that call for analysis and synthesis (*intuitive/reflective/global).*
- Give students opportunities to work together on assignments and group activities (*active).*
- Provide concrete examples of how a theory describes or predicts events (sensing/inductive); then develop the theory or formulate the model (*intuitive/inductive/sequential*); show how the theory can be validated and deduce its consequences (*deductive*).
- Recognize students' creative solutions or activities (*intuitive/global).*

Field-Dependent/Independent

Learning style, characterized as field-dependent and field-independent have been widely and extensively studied and has the broadest application to education concerns (Witkins, Dyk, Faterson, Goodenough, & Karp, 1962). Witkin, Moore, Goodenough, and Cox (1977) suggested that students who preferred a field-dependent learning style tended to perceive the world globally, found it more difficult to solve problems, were highly sensitive and attuned to the social environment, tended to favor the "spectator approach" to learning, and would adopt the organization of information to be learned. Additionally, students who preferred a field-dependent learning style were more extrinsically motivated and responsive to social reinforcement.

Conversely, students who preferred a field-independent learning style

tended to view the world more analytically, found it easier to solve problems, and were more likely to favor "inquiry" and independent study. In addition, field-independent students tended to provide their own structure to facilitate learning, were more intrinsically motivated, and were generally unresponsive to social reinforcement (Witkin et al., 1977). Table I summarizes the characteristics and behaviors associated with field-dependent and field-independent learning styles.

Insert Table 1 about here

It is important to note that learning styles are not always clustered into neat categories as described. A person's field dependent/independent learning style score, as measured by the Group Embedded Figures Test (GEFT) (Witkin, Ottman, Raskin, & Karp, 1971), falls along a continuum. Whereas extreme scores are common, Witkin et. al. noted that the world is not peopled by two distinctly different types of individuals, but rather that learning styles are distributed on an intermittent plane somewhere between and inclusive of abstract and concrete. Their Group Embedded Figures Test (GEFT) enumerates the degree of abstractness/concreteness on a scale of 0-18 (Figure 1).

Insert Figure 1 about here

A person with a learning style score that falls near the extreme end of the learning style continuum has a stronger preference for that learning style than a person with the same learning style whose score is closer to the middle. Therefore, the designations, "field-independent," like the designations, "tall" and "short," are relative (Witkin et. al., 1971).

According to Garton and Raven (1994) and Dyer (1995), a third category of learners also exists. These individuals score somewhere in the middle of the bipolar scale (Figure 2).

Insert Figure 2 about here

The Kolb Learning Style Inventory (Kolb, 1984, 1985) and the Myers-Briggs Type Indicator (Myers & McCaulley, 1985) are examples of self-scoring inventories that can help both individual students and instructors identify cognitive learning styles. Students who study individually and have choices can adapt activities and resources to their own styles.

Gregorc Style Delineator

The discussion of learning styles presented in this section is based on the research of Drs. Anthony Gregorc and Kathleen Butler (1984). Gregorc refers to the "four channels" through which the mind receives and expresses information most efficiently and effectively as mediation abilities. Mediation refers to your "linking" abilities. These are the abilities that link your brain to

the environment. Gregorc teaches that there are many of these abilities, but the two which seem to have the greatest effect on learning are the mediation abilities of perception and order.

Perception Abilities: The means through which you grasp information. This is the ability you have to see through the mind's eye. This ability enables you to perceive abstract and concrete data from the environment. Generally, one has a preference or dominant way of perceiving data from the environment.

> **Abstractness** is a mind quality that permits you to apprehend and perceive that which is invisible and formless to your physical senses.
>
> **Concreteness** is a mind quality that enables you to grasp and mentally register data through the direct use and application of the physical senses. This quality, according to Gregroc, enables you to apprehend that which is visible in the concrete, physical world through your physical senses.

Ordering Abilities: Ordering abilities are the ways in which you arrange, systematize, reference, and dispose information. This ability enables you to order information by *sequencing* or by *randomly* storing information.

> **Sequence** is the mind quality that disposes your mind to grasp and organize data from the environment in a linear, step-by-step, methodical, predetermined order. This quality

also encourages you to express yourself in a peruse, progressive, and logically systematic manner.

Randomness: This mind quality disposes your mind to grasp and organize information in a nonlinear, galloping, leaping, and varied manner. Large chunks of information can be imprinted on your mind in a fraction of a second. This quality enables you to deal with numerous, diverse and independent elements of information and activities.

All of us are equipped with all learning qualities. However, as Gregorc observes, most individuals are predisposed strongly toward one, two, or even three styles. Few individuals, according to Gregorc (1984), are equally strong in all four channels. Each combination of perception and ordering abilities reveals a particular quality to how we see and use the information we receive from the environment. The possible combinations of perception and ordering abilities are:

Concrete Sequential CS
Abstract Sequential AS
Abstract Random AR
Concrete Random CR

1. **Concrete Sequential** - The concrete sequential (CS) channel enables us to label, remember and control discrete parts of the physical environment. It is the basis of our ability to get things done in the concrete world, to work step-by-step, to follow specific directions and to move steadily toward the

completion of carefully developed plans of blueprints.

CS is also the channel that most vocational-technical fields require. It is needed to learn the basics in most vocational education laboratory courses. It uses such means of instruction as hands-on learning with guided practice, structured assignments, computers, machinery and equipment that demand precision in operation.

At the lowest level of CS abilities, students memorize, drill and prove their ability to perform machinery, technology or information. At the highest level, students create original products in precise forms. A student of high CS ability, for example, might be able to solve the heating design problem of an old house that is being restored. For CS learners, abstract ideas can be made real by translating them into students' reality. Instead of asking them to discuss the concept of harnessing energy, it would be better to ask them to discuss how different car engines harness energy.

2. **Abstract Sequential** - The abstract sequential (AS) Channel permits us to deal with abstract ideas, theories and hypotheses. It prompts us to be intellectual, logical and rational. When well-developed, this channel lets us view the overall picture, develop a blueprint or recipe from an idea and visualize the final product. The AS thinker is concerned with scope and sequence and enjoys developing long-range plans.

Abstract sequential vocational education students use their training to

gather information, concepts and theories about the mechanical and technological world. For them, hands-on training is a way to understand the working application of a subject rather than an end in itself. Although they may not realize it, their style of learning continually leads them to further training. For example, Joan began her coursework with drafting and blueprinting. Her ease, mastery and fascination with the field led her eventually to a master's degree in engineering.

3. **Abstract Random** - The abstract random (AR) channel helps us think with our emotions. It provides us with opportunities to experience the total environment - not just a teacher/student/machine lesson, but the temperature, sights and sounds, body language, attitudes and moods in the classroom.

   AR vocational education students channel their sensitivity and emotions through the hands-on world. They tend to enter fields such as marketing, fields that maximize relationship with others, permitting contact rather than isolation. In their trade, they seem to offer as much through their personalities as they do through their work. They have a natural ability to work well with people.

   At the lowest levels, AR learning demands general group discussion to pool ideas. At the highest level, it involves coopertive group activity, interpreting and understanding relationships, and creating aesthetic or interpretive products.

4. **Concrete Random** - The concrete random (CR) channel enables us to look into things to see what makes them tick. It prompts us to be inquisitive and question motives. It is also behind some of the breakthroughs in knowledge, since it encourages us not to think conventionally. When well-developed, the CR channel makes for excellent trouble-shooters and diagnosticians.

   CR learners investigate experiment and invest new ways of doing things. They might have difficulties in classes that demand step-by-step learning, especially if they enjoy discovering how things work by trial and error. Once CR students master the basics of a field, they often need opportunities to test their problem solving skills. They need to be guided but not dominated by the teacher.

   At the lowest levels, CR learners consider alternatives; at the highest level, they create original, unusual and varied products.

Teaching With Style

Teaching to style is something many teachers do because they are constantly varying their instructional methods. The following discussion will focus on how a concept or principle may be taught using Dr. Butlers Style Differentiated Instruction (SD) Strategy Chart. The use of this chart in teaching to style serves the following purposes:

- Helps you to focus on designing units or lessons so all types of learners have an equal opportunity to learn utilizing his/her dominant learning style.
- Helps you to design lessons that addresses all cognitive levels of learning.
- Provides opportunities for students to stretch their dominant learning style so they may develop *flexing, coping* and *adapting* abilities.

Flexing, Coping, and Adapting Abilities

We utilize our mind's strength through the use of our natural abilities. However, to learn more effectively and efficiently, we must also be able to develop and use abilities beyond our natural styles.

Below are some of the abilities described by Dr. Butler in her book, *Learning and Teaching Style in Theory and Practice.*

- Flexed style is an ability we use when we purposely and successfully work in another style.
- Adaptive style appears when we use a limited (non-dominant) style within ourselves.
- Coping style occurs when you overlook your natural mind channels in order to survive the demands of others.

Two ingredients are necessary in using flexing, adapting, or coping abilities. These ingredients are the power of concentration and energy. Dr. Butler states

that it requires a maximum amount of energy and concentration to cope with a teaching style that does not match your natural dominant learning style. Adapting abilities also require extra energy and concentration from the learner. It has been stated in education circles that educators can not pedagogically cause harm to the average and above average student. These students will learn in spite of how we teach. Whether these statements are true or not is arguable. However, research in learning theory is beginning to reveal some support based on the notion that students who high achieving possess energy and the ability to concentrate, two ingredients necessary to developing flexing, coping, and adapting abilities. Further, it seems that students who are in the lower quartiles of achievement have less energy and concentration power and conversely have developed less flexing, adapting, and coping abilities. Teaching using methods, strategies, and attention getting devices that match all learning styles of students in the lower half of the achievement scale is very important to:

1. Give every student an opportunity to learn rigorous concepts, principles, and applications using his/her dominant natural learning style and to
2. Develop and maintain flexing, adapting, and coping abilities.

Learning Modalities and Selected Teaching Techniques

Flaherty (1992) offers the following descriptions for four major kinds of learning modalities:

1. Kinesthetic (The doers)

Kinethetic learners are action students. They prefer to do something firsthand read about it later. They can appear impulsive to educators who generally prefer people to act only after studying first. These students most frequently will read to get meaning, such as consulting a manual on how to assemble a car. They are least likely of the four major groups to read for pleasure.

Kinesthetic students can be recognized by one or more of these traits:

- illegible cursive handwriting
- a tendency to stand close when they are conversing - close enough to be "in your space"
- poor test takers, although they often appear to know the material
- latent for working with hands-on projects in school

2. Tactual (Sensitive students)

Tactual students have a heightened awareness of their learning environment. These students are aware of how hot or cold the classroom is and whether it is too light or too dark for learning. Tactual students focus attention on non-verbal communication and are naturals at interpreting its meaning. They learn best in an environment in which they have respect and regard for the teacher. If you want to help these students learn, focus on building rapport with them. Tactual learners are overwhelmed with

their ability to connect with people, so they need special attention and an environment that is warm, welcoming, comfortable and caring.

3. **Auditory (Yakkety yak)**

   To comprehend material, they need to read out loud. They never finish those timed tests because they read for comprehension and not speed. Redesign your classes so that 50 percent of what is spoken is said by students. Provide small group discussions where auditory students compare ideas and learn by saying what they think and especially, hearing what they say, how they sound and how they come across to teachers and other students.

4. **Visual (The eyes have it)**

   Visual learners want everything in print: overheads, handouts, books and papers. Visual Students review their notes to study for an exam, while kinethetic learners will rewrite their notes to study and auditory students want to talk about it. Use written tests and reports as part of a comprehensive student performance portfolio. Teach by demonstration and observation so that students can reinforce their learning by seeing.

The following are suggested **teaching techniques** based on selected learning modalities.

Modality	**Technique**
Kinesthetic	This student needs a combination of stimuli. The manipulation of material along with the accompanying sights and sounds (words and numbers seen and spoken) will make a big difference to this student.
Auditory	This student will benefit from hearing audiotapes, role oral practice, lecture or a class discussion. This student will benefit from tutoring another or delivering an explanation to his/her study group or to the teacher.
Visual	This student will benefit from worksheets, workbooks, and texts. Given some time alone with a book, this student may learn more than in class.
Social-Individual	This student needs to be allowed to do important learning alone. Do not force group work on this student. This student will benefit from library assignments. Some great thinkers are loners.
Social-Group	Group interaction is suggested for this student.
Expressive-Oral	Allow this student to make oral reports instead of written ones. Evaluate this student based on what he/she says.
Expressive-Written	This student needs to be allowed to write reports, keep notebooks and journals for credit and take written tests for evaluation. Oral transactions should be under non-pressured conditions, perhaps even in a one-to-one conference.

Benefits of Understanding Learning Styles

The benefits of understanding learning styles are:

- Through an examination of your own learning style, learn more about yourself as a vocational education teacher.
- Learn more about others.
- Identify the implications your learning style has on your teaching.
- Examine and develop teaching methods that match various learning styles.
- Examine and develop teaching methods and strategies that provide all learners the opportunity to learn at all cognitive levels.
- Develop methods of learning that will enable students to stretch their natural dominant learning style to adapt or cope with various teaching styles.

Summary and Conclusions

By being aware of individual learning styles, including which learning conditions individuals prefer and cognitive learning styles, vocational education teachers can develop alternative instructional methods and a variety of learning resources.

Clearly, different technologies will appeal to different learning styles. The concrete sequential student might enjoy learning step-by-step with a computer while a concrete random student might feel more comfortable with the relative unpredictability of interactive video. Where an abstract sequential learner might sit still for a televised or video-taped lecture, the abstract random student demands more creative, thematic uses of video instructional technology.

The danger is in assuming that all will adapt to the new educational technologies with equal readiness and enthusiasm (Gregorc & Butler, 1984). Not all students are able to, or even want to, receive education exclusively by computer. Nor should they be made to suffer or feel inferior because of their preference. Teachers and administrators, therefore, must be sensitive to the differences in learning styles required by the new technologies.

Diagnosing and accommodating individual student learning style contributes to motivation for learning. An abundance of research supports the value of retraining weak cognitive skills and matching instruction with student style preferences. In general, the findings from the literature revealed that students' achievement increases, their attitude toward school becomes more positive, and behavioral difficulties decrease. For example, hands-on learning can be highly motivational for students who display a preference for learning with manipulatives. Short assignments can help students with low persistence achieve and gain momentum for continued achievement. Students are interested in knowing their learning style and its implication for how to structure their learning and study time.

If we are aware of the demands different technologies make on us, and understand why we like or dislike certain ones, perhaps we will be more patient with that computer or laser disc. Maybe we can be more appreciative of a particular student's finess with a certain tool. And possibly, we can be less critical of ourselves and more flexible in our approach to teaching and technology.

Table 1.

Characteristics and Behaviors Associated with the Field-Dependent and Field-Independent Learning Styles

Learning Style	
Field-Dependent	**Field-Independent**
Find it difficult to learn when the learning task involves several steps.	Able to accomplish learning tasks that involve several steps.
Experience difficulty in problem-solving situations.	Good at analytical problem-solving.
Prefer to have answers provided by the instructor.	Prefer an inquiry approach to learning.
Prefer externally defined goals and organization.	Can provide their own structure to learning activities.
Prefer a spectator approach to learning.	Prefer trial and error as opposed to being shown how.
Value positive reinforcement from the teacher.	Do not typically respond to positive reinforcement offered by teachers.
Have well-developed social skills and are more attuned to social cued.	Have poorly developed social skills and are more socially independent.
Favor extrinsic motivation.	Are intrinsically motivated.
Prefer collaboration.	Prefer competition.

ABSTRACT	11.3	CONCRETE
0	National Norm	18

Figure 1. GEFT Learning style scores.

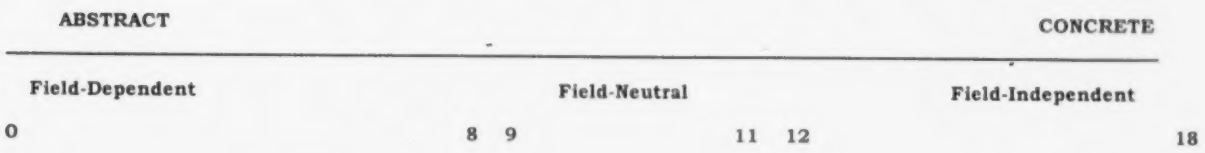

Figure 2. Classification for GEFT Scores

REFERENCES

Cano, J., Garton, B. L., & Raven, M. R. (1992 a). Learning styles, teaching styles and personality styles of preservice teachers of agricultural education. Journal of Agricultural Education, 33 (1), 46-52.

Cano, J., Garton, B. L., & Raven, M. R. (1992 b). The relationship between learning and teaching styles and student performance in a methods of teaching agriculture course. Journal of Agricultural Education, 33 (3), 16-22.

Cano, J., Metzger, S. (1995). The relationship between learning style and levels of cognition of instruction of horticulture teachers. Journal of Agricultural Education, 36 (2), 36-43.

Chinien, C. A., Boutin, F. (1993). Cognitive style FD/I: An important learner characteristic for educational technologists. Journal of Educational Technology Systems, 21 (4), 303-311.

Dunn, R., & Dunn, K. (1978). Teaching students through their individual learning styles: A practical approach. Reston, VA.: Reston Division of Prentice-Hall.

Dyer, J. E. (1995). Effects of teaching approach on achievement, retention, and problem solving ability of Illinois agricultural education students with varying learning styles. Unpublished doctoral dissertation. University of Illinois at Urbana-Champaign.

Felder, R. M., & Silverman, L. K. (1988). Learning and teaching styles in engineering education. Engineering Education, 78(7), 674-681.

Flaherty, G. (1992). The learning curve. Vocational Education Journal, 67 (6), 32-33, 56.

Garton, B. L. (1993). The relationship between agriculture teachers' learning style and problem-solving ability and the extent of use of the problem-solving approach to teaching. Unpublished doctoral dissertation. The Ohio State University, Columbus.

Garton, B. L., & Raven, M. R. (1994. November). Enhancing teaching and learning through the knowledge of learning styles. Unpublished manuscript. The Ohio State University, Columbus.

Gregorc, A. F., & Butler, K. A. (1984). Learning is a matter of style. VocEd, 59(3), 27-29.

Griggs, S. A. (1991). Learning styles counseling. (Reports no. EDO-CG-91-5). Ann Arbor, MI: Clearinghouse on Counseling and Personnel Services (ERIC Document Reproduction Service No. ED 341 890)

Keef, J. W., & Monk, J. S. (1986). Learning style profile. Reston, VA: National Association of Secondary School Principals.

Kolb, D. (1984). Experiential learning: Experience as the source of learning and development. Englewood Cliffs, NJ: Prentice-Hall.

Kolb, D. (1985). Self-scoring inventory and interpretive booklet. Boston: McBer.

Myers, I. B., & McCaulley, M. H. (1985). Manual: A guide to the development and use of the Myer-Briggs Type Indicator. Palo Alto, CA: Consulting Psychologists.

Torres, R. M. (1993). The cognitive ability and learning style of students enrolled in the college of agriculture at the Ohio State University. Unpublished doctoral dissertation. The Ohio State University, Columbus.

Witkin, H. A., Moore, C. A., Goodenough, D. R. & Cox, P. W. (1977). Field-dependent and field-independent cognitive styles and their educational implications. Review of Educational Research. 47 (1), 1-64.

Witkin, H. A., Oltman, P. K., Raskin, E., & Karp, S. A. (1971). Group embeded figures test manual. Palto Alto, CA: Consulting Psychologist Press.